may be taken as $1\ 42'$, but that of the star, 3°. Combining these values with the latitude, viz., $37^\circ\ 38'$, and using the formula

$$\sin\delta = \text{cos zen. dist.} \times \text{cos colat} + \text{sin zen. dist.} \times \text{sin colat} \times \text{sin ampl.},$$

we obtain for the star a declination of $+7^\circ\ 40'$, and for that of the Sun $+6^\circ\ 52'\ 22''$. This latter, with the ecliptic obliquity of about 800 years B.C., determines the Sun's right ascension to have been 1h. 3m. 15s.

The next step is to inquire if there be any bright star or star group which, at a date consistent with archæological possibility, would have had a declination near to the above-named place, and would also have been heliacal.

Such a star would have required about 6h. 8m. to pass from 3° altitude to the meridian, and it would have required to have been about $1\frac{1}{4}$h. in advance of the Sun to allow it to be seen. The approximate R.A. of such star would therefore be about 23h. 40m., and its declination, as already stated, must be about $7^\circ\ 40'$ N.

For trials I have used a stereographic projection of the sphere taken on the pole of the ecliptic, but showing also R.A. hours and parallels of declination. Any place on this projection may be chosen and marked on a superimposed sheet of tracing paper, and then if the tracing paper is turned round upon the pole of the ecliptic as a centre, so that the straight line drawn upon it, which in the first instance joined the two poles marked on the projection is carried round to an angle equal to the amount of precessional movement under consideration, if there be a suitable star marked on the projection the point selected for trial will pass over it or near it, and after the star has been thus roughly pointed out the more exact calculations may be proceeded with. By this process in the case before us the tracing-paper mark coincided almost exactly with the place of α Arietis, and for this star the particulars were carefully computed which have been given in the list of elements.

It should be noticed that there are in every case of intra-solstitial temples four possible solutions of this step. The Sun's amplitude may be due either to the vernal or the autumnal place, and the star might have been heliacal either at its rising or setting. In every instance all these four alternatives have been tried by the preliminary search method, and in every case in temples of old foundation an heliacal star has resulted from one or other of the trials, but never more than one.

The star which has been found as above for the Temple of Jupiter is no other than the brightest star of the first sign of the Zodiac, and therefore peculiarly suited to that god. The same star is connected with the early temple of Jupiter Olympius at Athens.

In intra-solstitial temples, by the nature of the case, the stars are almost entirely confined to the Zodiacal constellations, and consequently suitable stars are very much limited in number.

Another very great limitation arises from the consideration that, to have been of any service as a time warner, the star must have been heliacal, and when these two limitations are taken into account it becomes improbable to the greatest degree that there should always have been a suitable star unless it had been so arranged by the builders of the temple.

In about two-thirds of the cases which I have investigated the dates deduced from the orientations are clearly earlier than the architectural remains now visible above the ground. This is explained by the temples having been rebuilt upon old foundations, as may be seen in several cases which have been excavated, of which the archaic Temple of Minerva on the Acropolis of Athens and the Temple of Jupiter Olympius on a lower site are instances. There are temples also of a middle epoch, such as the examples at Corinth, Ægina, and the later temples at Argos and at Olympia (the Metroum at the last named), of which the orientation dates are quite consistent with what may be gathered from other sources.

Besides the list of intra-solstitial temples already given I have particulars of five for which I have been unable to find an heliacal star. They are all known to be of recent foundation, when other methods of measuring time had been discovered. The solar axial coincidences were no doubt in all these cases connected with the great festivals of these temples. It was clearly the case in two of them.

At the Theseum at Athens the date was either October 10 or March 2. The *Thesea* festival is reckoned to have been on October 8 or 9. For the later Erechtheum the day would have been April 8 or September 3. The great festival of this temple is put down for September 3.

Leaving the solar temples, we find that the star which was observed at the great Temple of Ceres must have been Sirius, not used, however, heliacally—although this temple is not extra solstitial—but for its own refulgence at midnight. The date so determined is quite consistent with the probable time of the foundation of the Eleusinian Mysteries and the time of year when at its rising it would have crossed the axis at midnight agrees exactly with that of the celebration of the Great Mysteries.

It is reasonable to suppose that when, as in the case of Sirius at Eleusis, brilliant stars were observed at night, the effect was enhanced by the priests by means of polished surfaces.

Herodotus, speaking of a temple at Tyre (B. II, 44), says:—

"*Καὶ ἐν αὐτῷ ἦσαν στῆλαι δύο, ἡ μὲν χρυσοῦ ἀπέφθου, ἡ δὲ σμαράγδου λίθου, λάμποντος τὰς νύκτας μέγαθος.*"

(Two shafts, one of pure gold, the other of emerald, which shone remarkably at night.)

Of a list of seven extra-solstitial temples which are named, five are more particularly noticed, viz. :—

A temple at Mycenæ and one near Thebes, which are built nearly north and south, but which probably, as was the case at Bassæ, had eastern doorways. The star, α Arietis, which suits the first, seems to point out the dedication of this temple to Jupiter. The other is very remarkable, and connects the Bœotian Thebes with the great Egyptian city; the star was γ Draconis. Thebes was called the City of the Dragon, and tradition records that Cadmus introduced both Phœnician and Egyptian worship. Three of the temples lay more nearly at an angle bisecting the cardinal points; these are Diana Propylæa at Eleusis, a small temple (not yet named) lately discovered at Athens, and the Temple of Venus at Ancona, recovered by means of the walls of a church built upon its traditional site. In these temples the star observed at the first seems to have been Capella, the time of the year when it shone axially at midnight agreeing with that of the celebration of the Little Mysteries, and in the other two the star was Arcturus.

EXPLORATIONS IN THE KARAKORAM.

MR. W. M. CONWAY gave an account of his recent exploring expedition in the Karakoram mountains at the last meeting of the Royal Geographical Society. The paper was illustrated by lantern slides, and a series of paintings by Mr. McCormick, who accompanied the expedition, was also exhibited. Mr. Conway said :—We left Srinagar on April 13, 1892, and came to Gilgit. Arrived at Gilgit we found the condition of the mountains, from a climber's point of view, too backward for our purposes. We therefore spent a month in mapping and exploring the fine Bagrot Valley, which slopes southwards from Rakipushi and its immediate neighbours along the main ridge. We hoped to be able to force a passage over this ridge into Nagyr ; but the persistent bad weather baulked our efforts when they were on the point of succeeding. When the traveller has emerged from the inhospitable defiles which sunder the valley of Hunza Nagyr from Gilgit, and has climbed the vast ancient moraines near Tashot, which form the final rampart of the fertile basin (fertile, of course, only by reason of artificial irrigation of admirable complexity and completeness), he stands surrounded by an astonishing view. The bottom of the valley is, as usual, deeply filled by *débris*, whose surface is covered by terraced fields, faced with cyclopean masonry, and rich with growing crops and countless fruit trees. The mountains fling themselves aloft on either hand, with astounding precipitancy, as it were into the uttermost heights of heaven ; so steeply, in fact, that a spring avalanche falling from the summit of Rakipushi on the south must almost reach the bottom of the valley. Rakipushi is 25,500 feet high; the Hunza peak is about 24,000 feet high. Their summits are separated by a distance of 19 miles. Both mountains are visible from base to summit at one and the same time from the level floor of the valley between them, which is not more than 7000 feet above the sea. No mountain view that I saw in the Karakorams surpasses this for grim wonder of colossal scale, combined with savage grandeur of form and contrast of smiling foreground.

Having been beaten back on June 24 from an attempt to

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reach the Bagrot Pass from the north, we returned to Nagyr, and started inwards towards the wholly-unknown region. We left Nagyr behind on June 27, and in a mile or two came to the foot of the Hopar Glacier. This glacier was once joined by the Hispar Glacier, and their united moraines were deposited at Nagyr, the town being actually built upon their crest. Now the foot of the Hispar Glacier has retreated some twenty miles into the mountains. The Hopar Glacier is greatly shrunken in width, and in its shrinkage it has left a fine, almost level area, beside its left bank, which is covered by the fields of Hopar.

We were delighted to find an enormous and almost unsuspected series of glacier basins above Barpu. In order to get some idea of them we spent a day mounting to the crest of the ridge north of our camp, which divides Barpu from the Hispar Valley. The view was of peculiar interest to us, for we looked for the first time into the Hispar Valley and beheld the long avenue of peaks that lined the way up the Hispar Glacier towards the unknown snowy regions through which lay our intended route into Baltistan. We reached the summit of the Hispar Pass on July 18, and Askole on the 26th, our slow progress being caused by the exigencies of the survey in weather that was oftener bad than fair.

We left Askole on July 31 and returned to it again on September 5, the intervening time having been spent over our expedition up the Baltoro Glacier and the ascent of Crystal and Pioneer Peaks. On September 10 we embarked on a skin raft, which carried us down the Shigar River to the Indus. We landed, and in half an hour reached the scattered villages of Skardo, capital of Baltistan. Of our journey from Skardo to Leh to verify our instruments, and from Leh back to Srinagar, it is unnecessary to speak. We reached Abbottabad on October 28, exactly seven months from the day on which we left it.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—During this term Prof. Clifton is lecturing on the optical properties of crystals, and other lectures and practical instruction are given by Mr. Walker and Mr. White at the Museum, by Mr. Baynes at Christchurch, by Sir J. Conroy at Balliol, and Mr. F. J. Smith at Trinity. In chemistry, Mr. Fisher and Mr. Watts are lecturing on inorganic and organic chemistry respectively, and Messrs. V. H. Veley and J. E. Marsh are demonstrators at the Museum. Mr. Vernon Harcourt is lecturing on inorganic chemistry at Christchurch, and Mr. D. H. Nagel at Trinity.

The professor of geology announces a course of lectures on economic geology and geological excursions. Prof. Ray Lankester is giving two courses, on embryology, and on the protozoa, rotifera, and urochorda; and supplementary lectures are given by Dr. Benham, Mr. J. Barclay Thompson, Mr. Bourne, and Mr. Minchin.

Prof. Burdon Sanderson is lecturing on the central nervous system, and has the assistance of Dr. Haldane and Mr. Pembury.

Prof. Vines is lecturing on outlines of classification, and has appointed Mr. P. Groom, of Cambridge, as demonstrator.

At the end of last term a sum of £3500 was voted by Convocation towards the renewal of a portion of the buildings and hothouses in the Botanic Garden. Prof. Vines made a full report on the condition of the houses at the end of last year, showing that all were old, of faulty construction, and so dilapidated as to entail a heavy annual expenditure for repairs. At the same meeting of Convocation a sum of £1000 was placed to the credit of the delegates of the University Museum, to be employed at their discretion for the maintenance and improvement of the collections in the Museum.

At a meeting of the Ashmolean Society on Monday, May 1, under the presidency of Mr. E. B. Poulton, Prof. A. W. Rücker, F.R.S., gave an interesting lecture on the electrical conductivity of thin films, which was largely attended.

On the 16th inst. Lord Kelvin will give the annual Boyle lecture to the Junior Scientific Club, and on the 18th the Romanes lecture will be given in the Sheldonian theatre by the Right Hon. T. H. Huxley.

CAMBRIDGE.—The term for which Mr. J. Y. Buchanan, F.R.S., was appointed to the University Lectureship in Geography expires at the end of the present term. The Committee of Selection for the appointment of a Lecturer to hold office for the next five years, will meet at Gonville and Caius Lodge on May 31. The stipend of the Lecturer is £200 a year, and he is required to deliver courses of Lectures in Geography during two terms at least, and to give informal instruction and assistance to students attending his lectures, and to promote the study of his subject in the University. The retiring lecturer is re-eligible. Candidates are to send their names and testimonials to the Master of Gonville and Caius College, on or before May 27.

The first Arnold Gerstenberg Studentship, of the value of £90 a year for two years, will be competed for in May, 1894, by men or women who have obtained honours in either part of the Natural Science Tripos, and whose first term of residence was not earlier than the Easter term 1888. The subjects of examination are Logic and Psychology, and the successful candidate must undertake to pursue a course of philosophical study.

Applications for permission to occupy the University's tables at the Zoological stations of Naples and Plymouth are invited; they should be addressed to Prof. Newton, and reach him on or before May 25.

The names of Prof. John Couch Adams, and of William, seventh Duke of Devonshire, have been inserted in the list of Benefactors of the University, recited at the annual Commemoration Service.

The plans for the Sedgwick Memorial Museum of Geology, prepared by Mr. T. G. Jackson, A.R.A., were approved, by a large majority, in the Senate on Thursday last. The work of construction cannot however be begun until the finances of the University, which this year show a deficit of some £4000, are in a more satisfactory state. A proposal to raise funds, by increasing the capitation-fee paid by undergraduates from 17s. to 40s. a year, is now before the Senate.

Alfred Eichholz, B.A., first class in both parts of the Natural Science Tripos 1891–92, with distinction in physiology, has been elected to a Fellowship at Emmanue College. Mr. Eichholz has already published papers of interest on physiological and anatomical subjects, and his election reflects great credit on his college.

SCIENTIFIC SERIAL.

Bulletin of the New York Mathematical Society, vol. ii. nos. 5, 6 (New York, 1893).—The earlier number opens with an account of the theory of substitutions (pp. 83–106), by Prof. Oskar Bolza. This is a warmly appreciative notice of Dr. F. N. Cole's translation of Netto's "Theory of Substitutions and its Applications to Algebra," to which attention has recently been drawn in our columns (see NATURE, pp 338, 339).—Dr. M. Bôcher in a bit of mathematical history (pp. 107–109) calls attention to a remarkable memoir by Euler ("De motu Vibratorio Tympanorum," 1764).—No. 6 contains a paper read before the New York Mathematical Society by Dr. T. Craig on some of the developments in the theory of ordinary differential equations (pp. 119–134). This is likely to be useful to students. Another paper read before the same Society is one entitled "On a General Formula for the Expansion of Functions in Series," by Prof. Echols (pp. 135–144), which is intended to be a brief exposition of a general theorem which forms the basis of a series of papers on certain determinant forms and their applications.—A short note follows by Dr. E. McClintock on the early history of the non-euclidian geometry (pp. 144–147), in continuation and part correction of his previous note in No. 2 of this volume. It discusses the claim to priority, brought forward recently by Prof. Beltrami, of Saccheri (1733) in his "Euclides ab omni nævo Vindicatus" as against Lobatschewsky.—"Notes" and "new publications" complete each number.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 16.—"On a Portable Ophthalmometer." By Dr. Thomas Reid, Glasgow. Communicated by Lord Kelvin, P.R.S.

The object of this instrument is to measure the curvature of the central area of the cornea, the polar or optical zone, and as this polar zone is the part of the cornea utilised for distinct vision, the instrument furnishes all the data practically requisite for the diagnosis and measurement of corneal astigmatism. Its use

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